

WHAT IS CLAIMED IS:

1. A process of manufacturing a nozzle plate for an ink-jet print head, said nozzle plate including (a) a substrate having an outside surface which is to be opposed to a print media, an inside surface which is opposite to said outside surface and nozzle holes which are formed through said substrate so as to be open in said outside and inside surfaces, and (b) a non-wetting layer which has a non-wetting characteristic and which covers said outside surface of said substrate, said process comprising:

a masking step of applying a resist on said inside surface of said substrate, and charging said nozzle holes with said resist such that portions of said resist protrude outwardly from openings of said nozzle holes on said outside surface;

a non-wetting-layer forming step of forming said non-wetting layer on said outside surface in a plating operation; and

an unmasking step of removing said resist from said substrate.

2. A process of manufacturing a nozzle plate for an ink-jet print head, said nozzle plate including (a) a substrate having an outside surface which is to be opposed to a print media, an inside surface which is opposite to said outside surface and nozzle holes which are formed through said substrate so as to be open in said outside and inside surfaces, and (b) a non-wetting layer which has a non-wetting characteristic and which covers

said outside surface of said substrate, said process comprising:

a substrate setting step of setting said substrate on a support, such that said outside surface is positioned downwardly of said inside surface, without openings of said nozzle holes on said outside surface being in contact with said support;

a masking step of applying an insulating material on said inside surface and charging said nozzle holes with said insulating material;

a non-wetting-layer forming step of forming said non-wetting layer on said outside surface; and

an unmasking step of removing said insulating material from said substrate,

wherein said masking step includes:

an insulating-material disposing step of disposing a resist as said insulating material on said inside surface of said substrate; and

a bar coating step of disposing a bar on said resist disposed on said inside surface, and moving at least one of said bar and said substrate relative to the other in a direction parallel to said inside surface such that portions of said resist protrude outwardly from openings of said nozzle holes on said outside surface of said substrate.

3. A process according to claim 2,

wherein said support has a large height portion and a small height portion,

and wherein said substrate is set on said support in said substrate setting step, such that said substrate is supported by said large height portion while each of said openings of said nozzle holes is positioned above said small height portion.

4. A process according to claim 2, wherein said bar coating step is implemented such that each of said portions of said resist protrudes outwardly from a corresponding one of said openings of said nozzle holes by at least 1  $\mu\text{m}$ .

5. A process of manufacturing a nozzle plate for an ink-jet print head, said nozzle plate including (a) a substrate having an outside surface which is to be opposed to a print media, an inside surface which is opposite to said outside surface and nozzle holes which are formed through said substrate so as to be open in said outside and inside surfaces, and (b) a non-wetting layer which has a non-wetting characteristic and which covers said outside surface of said substrate, said process comprising:

a through-holes forming step of forming through-holes as said nozzle holes in said substrate, by punching said substrate from said inside surface toward said outside surface;

a masking step of applying an insulating material on said inside surface and charging said nozzle holes with said insulating material;

a surface smoothing step of smoothing said outside surface;

a non-wetting-layer forming step of forming said non-wetting layer on said outside surface in a plating operation; and

an unmasking step of removing said insulating material from said substrate.

6. A process according to claim 5, wherein said nozzle holes are charged with a resist as said insulating material in said masking step such that portions of said resist protrude outwardly from openings of said nozzle holes on said outside surface of said substrate.

7. A process according to claim 5,  
wherein said masking step includes:

an insulating-material disposing step of disposing a resist as said insulating material on said inside surface of said substrate; and

a bar coating step of disposing a bar on said resist disposed on said inside surface, and moving at least one of said bar and said substrate relative to the other in a direction parallel to said inside surface such that portions of said resist protrude outwardly from openings of said nozzle holes on said outside surface of said substrate.

8. A process according to claim 6, wherein each of said portions of said resist protrudes outwardly from a corresponding one of said openings of said nozzle holes by at least

1  $\mu\text{m}$ .

9. A process according to claim 5, wherein said surface smoothing step is implemented by a lapping operation in which the outwardly protruding portions of said resist, together with burrs formed at edges of said openings of said nozzle holes on said outside surface in said through-holes forming step, are eliminated.

10. A process of manufacturing a nozzle plate for an ink-jet print head, said nozzle plate including (a) a substrate having an outside surface which is to be opposed to a print media, an inside surface which is opposite to said outside surface and nozzle holes which are formed through said substrate so as to be open in said outside and inside surfaces, and (b) a non-wetting layer which has a non-wetting characteristic and which covers said outside surface of said substrate, said process comprising:

a masking step of applying an insulating material on said inside surface and charging said nozzle holes with said insulating material, by superposing said substrate on a resist layer formed of a resist as said insulting material, such that said inside surface is brought into contact with said resist layer, so that said nozzle holes are charged with said resist owing to a capillary action of said resist;

a non-wetting-layer forming step of forming said non-wetting layer on said outside surface in a plating operation; and

an unmasking step of removing said resist from said substrate.

11. A process of manufacturing a nozzle plate for an ink-jet print head, said nozzle plate including (a) a substrate having an outside surface which is to be opposed to a print media, an inside surface which is opposite to said outside surface and nozzle holes which are formed through said substrate so as to be open in said outside and inside surfaces, and (b) a non-wetting layer which has a non-wetting characteristic and which covers said outside surface of said substrate, said process comprising:

a masking step of covering said inside surface of said substrate with a masking member;

a non-wetting-layer forming step of forming a non-wetting layer on said outside surface and inner surfaces of said nozzle holes;

an unmasking step of removing said masking member from said substrate; and

an irradiating step of irradiating portions of said non-wetting layer which cover said inner surfaces of said nozzle holes, such that the irradiated portions of said non-wetting layer lose the non-wetting characteristic.

12. A process of manufacturing a nozzle plate for an ink-jet print head, said nozzle plate including (a) a substrate having an outside surface which is to be opposed to a print media, an inside surface which is opposite to said outside surface and

nozzle holes which are formed through said substrate so as to be open in said outside and inside surfaces, and (b) a non-wetting layer which has a non-wetting characteristic and which covers said outside surface of said substrate, said process comprising:

a deforming step of plastically deforming portions of said substrate in which said nozzle holes are to be formed, in a direction away from said inside surface toward said outside surface, such that a recess and a protrusion are formed in said inside and outside surfaces of each of the deformed portions of said substrate, respectively;

a covering-layer forming step of forming a covering layer on said inside surface and an inner surface of said recess;

a surface smoothing step of smoothing said outside surface, so that said protrusion formed in said outside surface of each of the deformed portions of said substrate is eliminated whereby said recess formed in said inside surface of each of the deformed portions of said substrate converts into a corresponding one of said nozzle holes; and

a non-wetting-layer forming step of forming said non-wetting layer on said outside surface in a plating operation.

13. A process according to claim 12, wherein said covering layer formed in said inside surface and said inner surface of said recess is an insulating layer.

14. A process according to claim 13, wherein a thickness of said insulating layer formed in said insulating-layer

forming step is not smaller than a thickness of said non-wetting layer formed in said non-wetting-layer forming step.

15. A process according to claim 13, wherein said insulating layer formed in said inside surface and said inner surface of said recess is a layer made of silicon dioxide containing carbon.

16. A process according to claim 12, wherein said recess is formed in said inside surface of said substrate in said deforming step, such that said recess has a depth not smaller than a thickness of said substrate.

17. A process according to claim 12,  
wherein said covering layer formed in said inside surface and said inner surface of said recess is a metallic layer that is oxidizable under a condition under which said substrate is not oxidizable,

said process further comprising:

a layer oxidizing step which is implemented, before implementation of said non-wetting-layer forming step, so as to oxidize said metallic layer formed on said inside surface and said inner surface of each of said nozzle holes, such that said metallic layer converts into an oxidized layer.

18. A process according to claim 17, wherein a thickness of said metallic layer formed in said metallic-layer



forming step is not smaller than a thickness of said non-wetting layer formed in said non-wetting-layer forming step.

19. A process according to claim 17,  
wherein said substrate is made of stainless steel,  
and wherein a tantalum layer is formed as said  
metallic layer in said metallic-layer forming step.

20. A process according to claim 17,  
wherein said substrate is made of stainless steel,  
and wherein a copper layer is formed as said  
metallic layer in said metallic-layer forming step.

21. A process according to claim 17, wherein said  
recess is formed in said inside surface of said substrate in said  
deforming step, such that said recess has a depth not smaller  
than a thickness of said substrate.